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Transportation and Storage of Radium

1. Personnel Protection.

a. All technical personnel handling radium and all personnel whose duties require them to spend daily time within even possible over-exposure distance from radioactive material should be protected by adherence to the recommendations of the International X-ray and Radium Protection Committee.

- (1) Specification of protective measures will be made by the technical advisor in charge of specific radium problems and/or of the storage depot.
- (2) The enforcement of recommendations of technical advisor is a responsibility of command.

2. Handling: General Principles.

a. Movement of radium tubes and containers should be kept at an absolute minimum and should always be done by instrument, not by hand, regardless of the quantity of radium presumed present.

b. In any movement of radium, as many maneuvers as possible should be carried out by personnel who are unlikely to be in contact with radium again and as few as possible by technical personnel who are in more or less continuous contact with radioactive materials.

c. Radium and containers should be manipulated in dry open air or in well ventilated dry rooms.

d. The actual manipulation of radium tubes should be carried out by technical personnel only. The manipulation of containers should be done as little as possible by such personnel but should be done under technical supervision.

e. Except for personnel actually carrying out maneuvers, all other personnel should stay at least 50 feet distant from presumptive open radium (i.e. unprotected by any lead). For radium quantities in excess of 10 grams even greater distance is advisable.

f. The amount and filtration of radium to be moved will determine the amount and rate of exposure permissible for personnel, and will necessarily be

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determined in detail by technical personnel at the time of manipulation of a specific radium problem.

3. Transportation.

a. Means.

(1) Radium container.

- (a) This should be constructed of a lead wall with a thickness of 5 inches. Details of construction (to prevent leakage and provide capacity) should be discussed with a technical advisor.
- (b) This amount of lead protection will permit safe transportation of radium quantities as follows (as concerns continuous exposure of transporting personnel): See par 3b (7) below.

Up to 1 GM radium	plus 10 ft distance	for 16 hours per day
Up to 1 GM radium	plus 5 ft distance	for 4 hours per day
1 - 3 GM radium	plus 10 ft distance	for 6 hours per day
3 - 5 GM radium	plus 15 ft distance	for 6 hours per day
3 - 5 GM radium	plus 10 ft distance	for 3 hours per day.

- (c) This container should weigh not in excess of 600 to 700 lbs. Heavier containers of greater lead thickness and protection could be made but become difficult to maneuver.
- (d) The container should be mobile. It should be fixed on wheels with detachable handle 4 - 5 ft long.

(2) Container carrier (trailer).

- (a) A container carrier of "trailer" type should be available so constructed as to permit enclosure, firm fixation, and lock up of the radium container.
- (b) Construction should permit loading and unloading of container by ramp or mechanical lift.
- (c) Trailer should be attachable and detachable to a vehicle in such a way that a minimum distance of 10 ft lies between fixed container and the occupants of the vehicle. (See par 3a (1)(b) above.)

(3) Handling tools.

- (a) Tong or forcep type grasping tools should be provided having a minimum distance of 12 inches between hand grasp and object grasp. Two types should be available:

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- (1) Heavy - for the handling of small lead containers.
- (2) Light - for the manipulation of small tubes and capsules of radium salt. If possible this tool should have a hand guard of brass.
- (b) Three forceps of each (heavy and light) type should be available whenever radium tubes or small containers are to be manipulated.
- (c) Rubber gloves should be available to technical personnel manipulating radium tubes.

b. Procedure.

- (1) Principles outlined in par 2 should be observed and arrangements made so that all manipulation can be carried out quickly.
- (2) Trailer should be brought as close to the radium as possible, the container removed and rolled to the radium.
- (3) Radium tubes should be removed from the outside lead box if any, --but left in the usual protective gold or platinum capsules and small surrounding lead cylinders,--placed in the container and the container locked. (The container will be constructed of sufficient capacity to hold the usual small type of radium containing lead cylinder. However, the protection outlined in this memorandum is designed to be ample should other gold, platinum, and lead protection be missing from specific radium quantities.)
- (4) The container should then be rolled back to the trailer, fixed into it and the trailer locked.
- (5) Outside lead boxes may be saved and brought back with the radium if, in the opinion of the technical personnel, such boxes are usable. The small amount of radiation from these boxes can be ignored in exposure calculations but they should not be allowed to remain in contact with uncovered skin of personnel. If such boxes are not usable they should be taken off somewhere and buried.
- (6) Technical personnel should not, even if the quantity of radium is small (100-200 mgn), have further radiation exposure on the day that radium has been opened and transferred into container and trailer.
- (7) Length of time of transportation of radium per 24 hours will be governed by the limitations of par 3a (1)(b). Variations should be made only by a technical officer in charge of a specific radium problem (who can evaluate the effect of quantities and additional intrinsic or other filtration).

- (8) When the radium has been transported to the place of storage, procedures for unloading would reverse in order those for loading.

4. Storage.

a. Space.

- (1) Two adjacent rooms at ground level without under- or over-lying occupied rooms are preferable. They must be adequately ventilated. Damp rooms are unsuitable.
- (2) Each room should have minimum floor space of 25 x 25 ft and a wall height of 8 - 10 ft.
- (3) One room should be used as a storage room only and contain a lead safe or vault. The other room should be used as a work room only.
- (4) If two rooms cannot be made available, one room used for both storage and work room should have at least 30 x 50 ft of floor space.

b. Equipment.

- (1) Both rooms should be equipped with exhaust fans with control switch outside the room.
- (2) Radium safe or vault.
 - (a) The safe should offer equivalent protection of at least 12 inches (30 cm) lead, part of which could be provided with concrete or brick. (Specifications for lead substitution may be found in "Recommendations of the British X-ray and Radium Protection Committee, Sixth Revised Report, February 1943".)
 - (b) It should be so constructed with separate compartments that only small quantities of radium will be exposed at one time.
 - (c) Details of construction should be worked out by technical advisor and constructing agent and would depend considerably on the situation selected for the installation of such a vault. (The simplest vault principle can be worked out by a poured lead block set in brick on five sides, with bored out compartments covered by a rolling lead door.)
- (3) Work bench - well lighted and ventilated, with a minimum 1 inch lead-faced top surface and 1 inch vertical protective screen. Details of this screen should also be worked out with the constructing agent.

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- (4) Movable containers similar to those described under par 3a (1).
- (5) Handling tools - as described briefly under par 3a (3) in suitable sizes and quantities.
- (6) Lead and plain rubber gloves.

c. The principles for handling should follow the same general principles outlined under par 2. Only personnel trained in the handling of radium should have authority and responsibility for the minutiae of radium handling techniques.

By order of the Theater Chief Surgeon:

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